

REMARKS

Reconsideration of the application is respectfully requested.

I. Claim Status

Claims 1-7 are currently pending and stand rejected.

Claims 1-6 have been amended to correct minor grammatical errors. No new matter has been added.

Claim 1 was objected to for a grammatical error, Applicants have amended the claim to correct the error.

II. Specification

The Abstract has been amended to correct a grammatical error. No new matter has been added.

III. Claim Rejections

a) **35 U.S.C. § 102(a)**

Claims 1-7 stand rejected under 35 U.S.C. § 102(a) as anticipated by Ariga (WO 2004/002752, "Ariga"). Applicants respectfully traverse the rejection.

Ariga published January 8, 2004, and is applicable as a reference under 35 U.S.C. §102(a) since the present application was filed in the international stage on September 30, 2004. The present application claims priority through the PCT application to Japanese Application No. 2003-340351 filed on September 30, 2003. Thus, the priority date of the present application pre-dates the publication date

of Ariga. Applicants submit herewith, as **Exhibit A**, a certified literal English translation of the Japanese priority document along with a Certificate of Accuracy of Translation under 37 C.F.R. § 1.55, to perfect the claim of priority. Accordingly, Applicants respectfully submit that Ariga is not prior art to the present application under 35 U.S.C. § 102(a).

Additionally, Ariga claims priority to Japanese Application No. 2002-191992 ("JP '992"). JP '992 published February 5, 2004 and could be prior art under 35 U.S.C. § 102(a). However, as above, the present application claims priority to Japanese Application No. 2003-340351 filed on September 30, 2003. Thus, the priority date of the present application pre-dates the publication date of JP '992, and Applicants have perfected the priority. Accordingly, Applicants respectfully submit that the JP '992 publication is not prior art to the present application.

One further note, the European counterpart of Ariga published July 13, 2005, and is not prior art to this application.

Applicants respectfully request that the rejection be withdrawn.

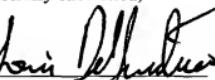
CONCLUSION

In view of the foregoing, Applicant believes the pending application is in condition is in condition for allowance, and earnestly solicits same.

If the Examiner feels that any remaining issues can be resolved through a Supplemental Amendment or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned at the telephone number indicated below.

Dated: June 26, 2008

Respectfully submitted,

By 
Louis J. DelJuidice
Registration No.: 47,522
DARBY & DARBY P.C.
P.O. Box 770
Church Street Station
New York, New York 10008-0770
(212) 527-7700
(212) 527-7701 (Fax)
Attorneys/Agents For Applicant

Application No. 10/574,040
Amendment dated June 26, 2008
Reply to Non-Final Office Action of April 2, 2008

Docket No.: 09852/0204249-US0

EXHIBIT A

DECLARATION

I, Youngsun JUNG, of SHIGA INTERNATIONAL PATENT OFFICE, 1-9-2, Marunouchi, Chiyoda-ku, Tokyo 100-6620, Japan, understand both English and Japanese, am the translator of the English document attached, and to hereby declare and state that the attached English document contains an accurate translation of the official certified copy of Japanese Patent Application No. 2003-340351 and that all statements made herein are true to the best of my knowledge.

Declared in Tokyo, Japan

This 13th day of June, 2008



Youngsun JUNG

[Title of the Document] Patent Application

[Docket Number] PX030279

5 5 [Filing Date] September 30, 2003

[Destination] Commissioner, Japan Patent Office

[International Classification] C09D175/00

10 [Inventor]
[Address] 7-33-12, Asumigaoka, Midori-ku, Chiba-shi, Chiba
[Name] Toshirou ARIGA

15 [Inventor]
[Address] 635-7, Ishikawa, Sakura-shi, Chiba
[Name] Yoshitomo NAGATA

[Inventor]
20 [Address] 3-5-1-2-202, Osakidai, Sakura-shi, Chiba
[Name] Takashi SUZUKI

[Applicant for Patent]

[Identification Number] 000002886

25 25 [Name] Dainippon Ink and Chemicals, Inc.

[Agent]
[Identification Number] 100088764
[Patent Attorney]

30 30 [Name] Katsutoshi TAKAHASHI
[Telephone Number] 03-5203-7758

[Official Fees]

[Prepayment Docket Number] 008257
[Amount of Payment] 21,000 Yen

[List of Documents Submitted)

5	[Item]	Claims	1
	[Item]	Specification	1
	[Item]	Abstract	1
	[General Power of Attorney Number]		0214178

[Document Type] Specification

[Title of the Invention] FILM FOR HYDRAULIC TRANSFER AND
HYDRAULICALLY TRANSFERRED BODY

[Technical Field]

5 [0001]

The present invention relates to a film for hydraulic transfer having a curable resin forming layer, and a hydraulically transferred body obtained by hydraulically transferring the film.

[Background Art]

10 [0002]

Hydraulic transfer method is capable of applying an intricately patterned decorative layer onto a complex three-dimensional molded product. However, an additional step is required after the hydraulic transfer in which a curable resin is spray coated onto the hydraulically transferred decorative layer as a protective layer. For this 15 reason, in manufacturing a molded product by the hydraulic transfer method, the production process is complicated and the coating equipment is required in addition to the hydraulic transfer equipment. Therefore, high costs are incurred and the molded body produced by the hydraulic transfer method is restricted to high-quality articles.

[0003]

20 As a means for solving the problems of the complication and high costs, a technique has been disclosed wherein a film for hydraulic transfer in which the transfer layer contains both a thermoplastic resin layer and a decorative layer is used to transfer the thermoplastic resin layer and the decorative layer to the transfer target body (for example, see patent reference 1). However, because in this technique the protection layer 25 is formed from a thermoplastic resin, specifically a copolymer of butyl acrylate and ethyl

acrylate, and the surface properties such as solvent resistance and surface hardness imparted to the transfer target body was inadequate.

[0004]

Furthermore, a method of manufacturing a molded product with a curable resin layer has been disclosed wherein a hydraulic transfer sheet is composed of a compound selected from a polymer having a glass transition temperature within a range from 0 to 250°C and containing radical polymerizable unsaturated groups, and a compound containing radical polymerizable unsaturated groups and having a melting point with in a range from 20 to 250°C, and the hydraulic transfer sheet is solid at room temperature in an uncured state and have a non-adhesive coating layer, and the coating layer is transferred to the transfer target body using the hydraulic transfer sheet, and then cured by ionizing radiation or heat (for example, see patent reference 2).

[0005]

However, even though the cured transfer layer obtained by the method disclosed in the claims and specification of the patent reference 2 solves the problems of drying property during coating and stability during storage at a same time, there were difficulties on activation of coating film during the hydraulic transfer only with a compound selected from a polymer having a glass transition temperature within a range from 0 to 250°C and containing radical polymerizable unsaturated groups. In addition, it was not possible to form a coating film having flexibility enable to wind up using only a compound containing radical polymerizable unsaturated groups and having a melting point with in a range from 20 to 250°C. It was very difficult to obtain a coating film having both flexibility and activation even with a combination of this compound and the compound selected from a polymer having a glass transition temperature within a range from 0 to

250°C and containing radical polymerizable unsaturated groups. Accordingly, it was difficult to solve the problems such as flexibility of the coating film enable to wind up, storage stability after winding up, solubility during the transfer suitable for activation and physical properties of the curable coating film, which are required as a hydraulic transfer sheet having the curable resin layer at the same time.

5 [0006]

As a measure against these problems, a method of adding thermoplastic resin or wax into the curable coating film is disclosed in the specification of patent reference 2. The patent reference 2 has no disclosure of specific examples regarding the method.

10 However, if it is practiced by known methods, there are some defects. For example, the property of the curable resin forming layer being solid at room temperature in an uncured state and non-adhesive is deteriorated, and even in cured coating film these thermoplastic components bleeds on the curable coating film after a certain period of time in high temperature within a range from 40 to 100°C being thought of as production condition, 15 and a significant defect of appearance on the surface of the cured coating film, swelling and peeling of the coating film are occurred.

For this reason, the hydraulic transfer film being solid in an uncured state and non-adhesive, and having good storage stability as a coating film, solvent solubility suitable for hydraulic transfer and surface physical property after curing is still not 20 provided.

[Patent Reference 1] Japanese Unexamined Patent Application, First Publication No. Hei 4-197699

[Patent Reference 2] Japanese Unexamined Patent Application, First Publication No. Sho 64-22378 (Japanese Examined Patent Application, Second Publication No. Hei 7-29084))

[Disclosure of the Invention]

5 [Problems to be solved by the Invention]

[0007]

Accordingly, an object of the present invention is to provide a film for hydraulic transfer with a curable resin forming layer having a non-adhesive property after drying while maintaining enough adherence to a water-soluble supporting film and coating film 10 forming capability in uncured state, and showing enough appearance conservation after forming the hydraulic transfer film, and further showing a high hardness or solvent resistance after curing by an active energy beam while being possible to activate by an organic solvent during the hydraulic transfer.

[Means for Solving the Problems]

15 [0008]

The inventors of the present invention conducted intense research to solve the problems, and discovered that the problem could be solved by using a curable resin layer which combines a radical polymerizable compound having a weight average molecular weight no more than 3,000 and a specific thermoplastic resin having a weight average 20 molecular weight within a range from 5,000 to 300,000 with a specific ratio, and accomplished the present invention. According to the present invention, a coating and adherence property to a water-soluble supporting film, and storage stability and drying after coating, and further activation by an organic solvent is possible. In addition, curing is achieved at the same time by a radiation of an active energy beam after transfer.

25 [0009]

More specially, the present invention provides a film for hydraulic transfer having a supporting film comprising a water-soluble or water-swelling resin, and a transfer layer that is soluble in organic solvent provided on top of said supporting film, in which

5 said transfer layer comprises a curable resin forming layer that is curable by
irradiation with at least one of an active energy beam or heat, wherein
said curable resin forming layer comprises:

1) a thermoplastic resin (A) selected from the group consisting of acrylic resins and polyester resins having a weight average molecular weight within a range from 5,000 to 300,000, and,

10 2) a radical polymerizable compound (B) selected from the group consisting of epoxy acrylates, polyester acrylates, urethane acrylates, and polyether acrylates, having a weight average molecular weight 10,000 or less and being compatible with said thermoplastic resin (A), and

15 a weight ratio P of the radical polymerizable compound (B) relative to the thermoplastic resin (A) (a combined weight of the polymerizable compound (B)/a combined weight of the thermoplastic resin (A)) in the curable resin forming layer being within a range from 45/55 to 70/30, and

20 the radical polymerizable compound (B) comprises a radical polymerizable compound (B1) having a weight average molecular weight within a range from 700 to 10,000.

The curable resin forming layer in the present invention means to a layer of in non-cured state during transfer process, and forming a curable resin layer after curing. The curable resin layer means a layer formed by curing reaction after transfer.

In addition, the present invention provides a hydraulic transferred body by hydraulically transferring a film for hydraulic transfer.

[Effects of the Invention]

[0011]

5 A hydraulic transfer film of the present invention has properties as follows;

- (1) a good storage stability such as flexibility enable to roll up even in non-cured state and an appearance stably maintained without blocking after rolling up is shown,
- (2) an even activation during hydraulic transfer process is obtained, and
- (3) a high hardness, high luster and solvent resistance due to curing by an active 10 energy beam after transfer is shown.

[Best Mode for Carrying out the Invention]

[0012]

(Supporting film)

The supporting film composed of a water-soluble or water-swelling resin used in 15 the film for hydraulic transfer of the present invention is a film formed from a resin that either dissolves or swells in water.

As the supporting film composed of a water-soluble or water-swelling resin, films as PVA (polyvinyl alcohol), polyvinylpyrrolidone, acetylcellulose, polyacrylamide, acetylbutylcellulose, gelatin, glue, sodium alginate, hydroxyethylcellulose, and 20 carboxymethylcellulose can be used.

[0013]

Of these films, PVA film, which is typically used as a film for hydraulic transfer, is most preferred because it dissolves easily in water, is readily available, and is also suited to printing of the curable resin layer. The thickness of the supporting film is 25 preferably within a range from 10 to 200 μm .

[0014]

(Transfer layer)

The transfer layer provided on top of the supporting film of the film for hydraulic transfer of the present invention includes a curable resin forming layer that can be cured 5 by at least one of an active energy beam or heat (hereafter referred to as the curable resin forming layer). Furthermore, the transfer layer may contain the curable resin forming layer, and a decorative layer composed of a printed ink coating film or a coating film (hereafter referred to as the decorative layer) provided thereon. The curable resin forming layer in the present invention can form a non-adherent film at room temperature 10 even before curing, and does not cure at room temperature, but can be cured by at least one of an active energy beam or heat.

[0015]

(Curable resin forming layer)

A thermoplastic resin (A) is preferably comprised 25 weight % or greater, more 15 preferably 30 weight% or greater, in a curable resin forming layer used in the present invention to ensure a better forming property, drying property, and storage stability of coating film.

Further, a radical polymerizable compound (B) having high solubility is preferably used 45 weight% or greater to ensure solubility during transfer.

20 (Weight ratio P between thermoplastic resin (A) and radical polymerizable compound (B))

The weight ratio P of the radical polymerizable compound (B) relative to the thermoplastic resin (A) (a combined weight of the radical polymerizable compound (B)/a combined weight of the thermoplastic resin (A)) in the present invention is preferably

within a range from 45/55 to 75/25, more preferably from 50/50 to 70/30, and most preferably 60/40.

However, a range from 45/55 to 60/40 is preferred in cases where the drying property of the film coating is of greater importance, or the coating is a thin film with a 5 thickness of 10 μm or less, such as when the film coating is formed using a printing device such as a gravure printing process or the like. To enhance the drying property even further, a polyacrylate with a weight average molecular weight of 150,000 or greater or a polyester with a weight average molecular weight of 30,000 or greater is preferably used as the thermoplastic resin.

10 In cases where the decorative layer is transferred onto the curable resin layer by using dry lamination to bond the curable resin forming layer to the decorative layer provided on the substrate film, cases where adequate drying time can be ensured such as when using a coating machine, and cases where activation is a greater issue such as when providing a thick film coating of at least 10 μm , the weight ratio P of the radical 15 polymerizable compound (B) relative to the thermoplastic resin (A) is preferably within a range from 50/50 to 70/30, and more preferably 60/40.

[0016]

In addition, polyacrylates having a weight average molecular weight within a range from 20,000 to 300,000 and polyesters having a weight average molecular weight 20 within a range from 5,000 to 50,000 is preferably used as a thermoplastic resin (A) to facilitate activation.

If the molecular weight of the thermoplastic resin (A) is larger such as over 300,000, the activation of the curable resin forming layer by an organic solvent before curing is likely to be difficult. Further, if the molecular weight is less than 20,000, it

becomes hard to control the fluidity or adherence property of uncured curable resin forming layer, and the coating property deteriorates due to transition of the thermoplastic resin in coating after curing to the surface of coating in high temperature.

[0017]

5 A glass transition temperature (Tg) of the thermoplastic resin (A) is preferably within a range from 25 to 250°C, and more preferably 50 to 150°C. If Tg of the thermoplastic resin (A) is less than 20°C, it becomes hard to control the adherence property of uncured curable resin forming layer, and the heat resistance of coating film after curing is adversely affected. In addition, if Tg is greater than 250°C, the
10 compatibility with the curable resin becomes not good.

[0018]

The combined weight% of the thermoplastic resin (A) and the radical polymerizable compound (B) within the curable resin forming layer is preferably 60 weight% or greater.

15 [0019]

Examples of the thermoplastic resin (A) is preferably poly (meth)acrylates or polyester, and it can be used along with polystyrene, polyvinyl chloride, poly vinylidene chloride, polyvinyl acetate, polyester, polyurethane, nitrocellulose, cellulose acetate butylate and so on. Vinyl resin can be a homopolymer or copolymer consisting of
20 different type of vinyl monomers.

[0020]

Among them, polystyrene and poly(meth)acrylate is preferable because their Tg is high and they are suitable for improvement of the drying property of the curable resin forming layer. More specially, poly(meth)acrylate having poly methyl methacrylate as a

main component and a weight average molecular weight within a range from 20,000 to 300,000 and more preferably 50,000 to 300,000 is preferable because it has good properties on transparency, solvent resistance, and abrasion resistance.

[0021]

5 The adherence property onto the supporting film or between the transferred body and the curable resin forming layer can be improved by controlling acid value of polymer being about 1 to 10 using radical polymerizable monomers having carboxylic groups such as (meth)acrylic acids as a copolymerizable component of poly(meth)acrylate.

[0022]

10 If the amount of the thermoplastic resin (A) is too much, the curing reaction of the curable resin may be inhibited and moreover the adherence property onto the water-soluble supporting film deteriorates.

[0023]

15 The thermoplastic resin having said Tg and molecular weight can be easily available as an improving agent of luster, weather resistance and solvent resistance of coating materials.

[0024]

As the film thickness of the curable resin forming layer increases, the protection effect on the obtained molded product also increases, and the curable resin forming layer 20 is better able to absorb the surface irregularities of the decorative layer, giving the molded product excellent luster. Accordingly, the film thickness of the curable resin forming layer is preferably at least 3 μm , and more preferably at least 15 μm . If the thickness of the curable resin forming layer exceeds 200 μm , it is difficult to achieve adequate activation of the curable resin forming layer with the organic solvent. In terms

of achieving adequate activation of the curable resin forming layer with the organic solvent, achieving favorable performance as a protective layer for the decorative layer, and absorbing the irregularities in the decorative layer, the dry film thickness of the curable resin forming layer is preferably within a range from 3 to 200 μm , and more

5 preferably from 15 to 70 μm .

[0025]

(Active energy beam)

The active energy beam refers to visible light, ultraviolet rays, electron beams, and gamma rays, any of which can be used, but ultraviolet rays is particularly preferred.

10 Sources of ultraviolet rays include sunlight, low-pressure mercury lamps, high-pressure mercury lamps, ultra-high pressure mercury lamps, carbon arc lamps, metal halide lamps, and xenon lamps.

[0026]

(Radical polymerizable compound (B))

15 For the curing reaction to proceed efficiently within the curable resin forming layer, the reactive groups are preferably able to move sufficiently freely within the matrix, and consequently the glass transition temperature of the radical polymerizable compound (B) is preferably less than 0°C. The radical polymerizable compound (B) comprises a radical polymerizable compound (B1) having a weight average molecular weight within 20 a range from 700 to 3,000, and more preferably 700 to 1,500 as an essential component in order to bring the coating forming property compatible with the solubility property in the transfer process.

The radical polymerizable compound (B1) is preferably comprised in the radical polymerizable compound (B) in amount of 80 to 100 weight%, and more preferably 90 to 100 weight%.

A low molecular weight radical polymerizable compound (B2) with a weight 5 average molecular weight of at least 200 but less than 700 may be added together with the radical polymerizable compound (B) which is an essential component. The low molecular weight radical polymerizable compound (B2) moves more readily within the curable resin forming layer than the radical polymerizable compound (B1), and is therefore used effectively in situations when a stronger cured film coating must be 10 obtained. However, if the quantity of the radical polymerizable compound (B2) added is too great, the film coating tends to bleed out and seep into the decorative layer, and cause film thickness variation in the film coating, and consequently the quantity added of the low molecular weight radical polymerizable compound (B2) should preferably not exceed 20 weight% of the radical polymerizable compounds.

15 [0027]

The weight ratio Q of the radical polymerizable compound (B2) relative to the radical polymerizable compound (B1) (a combined weight of the radical polymerizable compound (B2)/a combined weight of the radical polymerizable compound (B1)) in the present invention is preferably not more than 20/80.

20 [0028]

Most of the supporting film comprising a water-soluble or water-swelling resin used in the present invention have a low heat resistance, and therefore some problems of the dimensional stability of the film being deteriorated and the film being stretched or broken generally occur in drying furnace with 120°C or greater. For this reason, the

curable resin forming layer which is dried enough in the drying condition of 120°C or below is preferred. From these conditions, (meth)acrylates having any one of methacryloyl groups or acryloyl groups are preferably used as the radical polymerizable compound (B).

5 [0029]

(Radical polymerizable compound (B1))

Preferably the radical polymerizable compound (B1) having a weight average molecular weight within a range from 700 to 3,000, comprising a radical polymerizable group or radical polymerizable structural unit, and having a glass transition temperature 10 of 0°C or below has more than one acryloyl groups or methacryloyl groups per molecule, and more preferably 2 to 8, as a radical reactive unsaturated group.

[0030]

The acrylates preferably include urethane acrylates, polyester acrylates, epoxy acrylates and polyether acrylates, and more preferably urethane acrylates. Urethane 15 acrylates is preferred to improve the adherence property onto the supporting film comprising a water-soluble or water-swelling resin used in the present invention due to its high adherence property onto the supporting film.

[0031]

Urethane (meth)acrylates are (meth)acrylates that have a urethane linkage within 20 the molecule. These can be obtained by reacting hydroxyl group-containing (meth)acrylates, polyisocyanates, and polyols, for example. Depending on the purpose, it may be possible to use a urethane (meth)acrylate formed from a hydroxyl group-containing (meth)acrylate and a polyisocyanate, without using a polyol as a raw material.

[0032]

As the hydroxyl group-containing (meth)acrylate, hydroxyalkyl (meth)acrylates or ether extensions or lactone extensions thereof can be used, and for the various polyols, those with a structure in which a portion of the hydroxyl groups have been converted to a (meth)acrylate, and the various carboxylate esters of glycidyl (meth)acrylate and the like 5 can be used. Specifically, hydroxyalkyl (meth)acrylates with 2 to 8 carbon atoms such as 2-hydroxyethyl (meth)acrylate and 4-hydroxybutyl (meth)acrylate, (poly)ethylene glycol mono(meth)acrylate, (poly)propylene glycol mono(meth)acrylate, poly(ethylene glycol-propylene glycol) mono(meth)acrylate, poly(propylene glycol-tetramethylene glycol) mono(meth)acrylate, ϵ -caprolactone extensions of 2-hydroxyethyl (meth)acrylate, as well 10 10 as glycerol mono(meth)acrylate, glycerol di(meth)acrylate, pentaerythritol triacrylate, dipentaerythritol pentaacrylate, tris(2-hydroxyethyl) diacrylate and the like, and acid adducts of glycidyl (meth)acrylate using acetic acid, propionic acid, p-tert-butylbenzoic acid, and fatty acids and the like, can be used.

[0033]

15 As the polyisocyanate used in the urethane acrylate, aromatic polyisocyanates, aliphatic polyisocyanates, cyclic aliphatic polyisocyanates, and polyisocyanates with an isocyanurate structure can be used. Specific examples include tolylene diisocyanate, xylylene diisocyanate, methylene diphenyl diisocyanate, naphthalene diisocyanate, isophorone diisocyanate, 2,2,4-trimethylhexamethylene diisocyanate, 1,6-hexanediol 20 diisocyanate, hydrogenated xylylene diisocyanate, hydrogenated methylene diphenyl diisocyanate, dimer acid diisocyanate, lysine diisocyanate, as well as trimers of 1,6-hexanediol diisocyanate and isophorone diisocyanate which form an isocyanurate skeleton.

[0034]

As the polyol used in the urethane acrylate, polyether polyols, polyester polyols, polycarbonate polyols, and polybutadiene polyols and the like can be used, and according to circumstances, a polyol that has been modified using a polysiloxane or a fluoroolefin copolymer or the like can also be used.

5 [0035]

The polyester (meth)acrylate is (meth)acrylate obtained, for example, by the esterification of a polybasic acid or anhydride thereof, a polyol, and a (meth)acrylate or anhydride thereof. Depending on the purpose, it may be possible to use a polyester (meth)acrylate formed from a polyol and a (meth)acrylate or anhydride thereof, without 10 using a polybasic acid or anhydride thereof. In addition, a polyester (meth)acrylate obtained by reacting the carboxyl groups of a polyester synthesized using ordinary methods with a (meth)acrylate having an epoxy group can also be used.

As the polybasic acid, aromatic polybasic acids, chain-like aliphatic polybasic acids, and cyclic aliphatic polybasic acids and the like can be used. As the polyol, 15 alkylene polyols can be used, for example.

[0036]

An epoxy (meth)acrylate is a (meth)acrylate obtained, for example, by reacting a polyepoxide with (meth)acrylic acid or the anhydride thereof. Examples of suitable polyepoxides include bisphenol A type epoxy resin, phenol novolak type epoxy resin, 20 and polyol polyglycidyl ether.

[0037]

A polyether (meth)acrylate is a (meth)acrylate obtained, for example, by the esterification of a polyether with (meth)acrylic acid or the anhydride thereof. Examples of suitable polyether include polyethylene glycol, polypropylene glycol,

polytetramethylene glycol, and other branched alkyl polyols or bisphenol A type skeleton, polysiloxane chains.

[0038]

(Radical polymerizable compound (B2))

5 The low molecular weight radical polymerizable compound (B2) with a weight average molecular weight of at least 200 but less than 700 can be selected appropriately from the various conventional vinyl monomers, according to the characteristics required.

Preferred examples include the various (meth)acrylates, as well as allyl ethers, and unsaturated carboxylate esters, and in terms of curability, acrylates are even more

10 preferred. Furthermore, the number of radical polymerizable unsaturated groups within these compounds is typically at least one group per molecule, and preferably from 2 to 6 groups per molecule.

[0039]

Examples of these compounds include 1,6-hexanediol di(meth)acrylate, 1,9-

15 nonanediol di(meth)acrylate, neopentyl glycol di(meth)acrylate, glycerol di(meth)acrylate, neopentyl glycol hydroxypivalate diacrylate, polyethylene glycol di(meth)acrylate, polypropylene glycol di(meth)acrylate, polytetramethylene glycol di(meth)acrylate, epichlorohydrin-modified polypropylene glycol diacrylate, ethylene oxide-modified bisphenol A di(meth)acrylate, tris(2-hydroxyethyl) isocyanurate

20 diacrylate, glycerol tri(meth)acrylate, ethylene oxide-extended glycerol tri(meth)acrylate, propylene oxide-extended glycerol tri(meth)acrylate, trimethylolpropane tri(meth)acrylate, ethylene oxide-extended trimethylolpropane triacrylate, propylene oxide-extended trimethylolpropane triacrylate, mixtures of pentaerythritol triacrylate and pentaerythritol tetraacrylate, and dipentaerythritol hexa(meth)acrylate. Of these, 25 mixtures of pentaerythritol triacrylate and pentaerythritol tetraacrylate are preferred.

[0040]

(Photopolymerization initiator)

The curable resin forming layer may contain a conventional photopolymerization initiator or photosensitizer if required. Representative photopolymerization initiators 5 include acetophenone-based compounds such as diethoxyacetophenone and 1-hydroxycyclohexyl-phenyl ketone, benzoin-based compounds such as benzoin and benzoin isopropyl ether, acylphosphine oxide-based compounds such as 2,4,6-trimethylbenzoindiphenylphosphine oxide, benzophenone-based compounds such as benzophenone, methyl o-benzoylbenzoate, and 4-phenylbenzophenone, thioxanthone-based compounds such as 2,4-dimethylthioxanthone, and aminobenzophenone-based 10 compounds such as 4,4-diethylaminobenzophenone.

[0041]

The quantity of the photopolymerization initiator is typically within a range from 0.5 to 15 weight%, and preferably from 1 to 8 weight%, relative to the active energy 15 beam curable resin. Examples of suitable photosensitizers include amines such as triethanolamine and ethyl 4-dimethylaminobenzoate. In addition, onium salts such as benzylsulfonium salts, benzylpyridinium salts, and arylsulfonium salts are known as photocationic initiators, and these initiators can also be used, either alone or in combination with the photoradical generators mentioned above.

20 [0042]

(Thermoplastic resin (A))

The thermoplastic resin (A) used in the curable resin forming layer used in the present invention can cause the significant improvement of the drying property and glass transition temperature of the curable resin forming layer, and improve the appearance 25 stability of the coating film during storage of the film.

[0043]

(Decorative layer)

The printed ink or coating used as the decorative layer provided on top of the curable resin forming layer is preferably activated by the organic solvent and softened 5 sufficiently to effect transfer, and formation of the decorative layer by printing using gravure printing ink after the curable resin forming layer has dried is particularly desirable.

[0044]

As the varnish resin used in the printed ink or coating, thermoplastic resins such 10 as acrylic resins, polyurethane resins, polyamide resins, urea resins, epoxy resins, polyester resins, vinyl resins (vinyl chloride resins, vinyl acetate resins, and vinyl chloride-vinyl acetate copolymer resins), vinylidene resins (vinylidene chloride, vinylidene fluonate), ethylene-vinyl acetate resins, polyolefin resins, chlorinated olefin resins, ethylene-acrylic resins, petroleum-based resins, and cellulose-derivative resins can 15 be used

[0045]

Pigments are preferred as the colorant used within the printed ink or coating, and either organic or inorganic pigments can be used. Furthermore, a metallic gloss ink containing 20 as a pigment, metal flecks obtained from a paste of metal cutting particles or an evaporated metal film can also be used. Preferred metals include aluminum (Al), gold (Au), silver (Ag), brass (Cu-Zn), titanium (Ti), chrome (Cr), nickel (Ni), nickel chrome (Ni-Cr), and stainless steel (SUS). These metal flecks may also be subjected to surface treatment with an epoxy resin, polyurethane, acrylic resin, or cellulose derivative such as nitrocellulose, in order to enhance dispersibility, oxidation resistance, and the strength of 25 the ink layer.

[0046]

The decorative layer can be formed on the curable resin forming layer formed on the supporting film not only by gravure printing, but also by other techniques such as offset printing, screen printing, inkjet printing, and thermal transfer printing. The dry film thickness of the decorative layer is preferably within a range from 0.5 to 15 μm , and more preferably from 1 to 7 μm . Furthermore, unpatterned colored layers and colorless varnish resin layers can also be formed by a coating process.

[0047]

Various commonly used additives can be added to the curable resin layer and the decorative layer, including antifoaming agents, sedimentation inhibitors, pigment dispersants, fluidity modifiers, blocking inhibitors, lubricants, antistatic agents, antioxidants, photostabilizers, and ultraviolet absorbers, provided their use does not impair the design freedom or spreadability of the layer.

[0048]

A hydraulic transfer film obtained according to the present invention has a low blocking property, and the unnecessary curing reaction does not proceed if the film is covered with lightproof paper and stored in the dark room. The curing resin forming layer, or the curing resin forming and the decorative layer are activated by an organic solvent during the hydraulic transferring, and able to be transferred. The film has a sufficient market circulation unless it is intentionally exposed to ultra-violet or solar light.

[0049]

The low blocking property means that the surface of the coating film does not adhere to the supporting film when peeling off the surface of the coating film and the supporting film, and is easily peeled off. The test is performed by superimposition of the

surface of the coating film printed or coated after superimposing the decorative layer and the curable resin forming layer dried for one minute at 120°C, and the supporting film, followed by being left for one week at 20°C with a load of 1 Kg/cm² by blocking tester.

[0050]

5 (Method of producing hydraulically transferred body)

In the present invention, the method of producing a molded product having either a curable resin forming layer or both a decorative layer and a curable resin forming layer is similar to methods used with conventional films for hydraulic transfer, in that the film for hydraulic transfer of the present invention is floated on water with the supporting film 10 facing downward, the transfer layer containing either the curable resin forming layer or both the decorative layer and the curable resin forming layer is activated by an organic solvent, the transfer layer is hydraulically transferred onto the transfer target body, the supporting film is removed, and the transfer layer is then cured by irradiation with one of an active energy beam or heat. An overview of a method of producing a decorative 15 molded body using a film for hydraulic transfer is described below.

[0051]

(1) The film for hydraulic transfer is floated on water in a tank with the supporting film facing downward and the transfer layer facing upward, and the supporting film is dissolved or swelled in the water.

20 (2) The transfer layer composed of the curable resin forming layer or the cured resin layer and the decorative layer is activated by coating or spraying an activator onto the transfer layer of the film for hydraulic transfer.

Alternatively, the transfer layer may be activated by an organic solvent before the film is floated in water.

(3) The transfer target body and the film for hydraulic transfer are gradually submerged in the water by pushing the transfer target body down onto the transfer layer of the film for hydraulic transfer, and the transfer layer is transferred by adhering firmly to the transfer target body due to hydraulic pressure.

5 (4) The transfer target body is taken out of the water, the supporting film is removed, and the curable resin forming layer of the transfer layer that has been transferred to the transfer target body is cured by irradiation with one of an active energy beam or heat, thereby obtaining a molded product having either a cured resin layer, or a cured resin forming layer and a decorative layer.

10 [0052]

The transfer layer of the film for hydraulic transfer of the present invention, composed of either a curable resin forming layer or a curable resin layer and a decorative layer, is activated by coating or spraying an organic solvent onto the layer, thereby sufficiently solubilizing or softening the layer. Activation in this context refers to 15 improving the shape followability and adhesion of the transfer layer to the transfer target body, by imparting the transfer layer with greater flexibility by coating or spraying the transfer layer with an organic solvent, thereby solubilizing the layer without completely dissolving it. The extent of this activation should be such that when the transfer layer is transferred from the film for hydraulic transfer to the transfer target body, the transfer 20 layer is softened sufficiently to conform to the shape of the three-dimensional curved surface of the transfer target body.

[0053]

The water in the tank used in the hydraulic transfer process swells or dissolves the supporting film, and also acts as the hydraulic medium which causes the film for 25 hydraulic transfer to adhere to the three-dimensional surface of the transfer target body

during transfer of the transfer layer. Specific examples of the water include tap water, distilled water, and ion exchange water, and depending on the type of supporting film used, a solution in which up to 10% of an inorganic salt of boric acid or the like or an alcohol has been dissolved in the water may also be used.

5 [0054]

(Activator)

The activator is an organic solvent that imparts flexibility by solubilizing, i.e. activating either the cured resin layer or the curable resin forming layer and decorative layer. The activator preferably does not evaporate before the hydraulic transfer process

10 is complete. Activators typically used in hydraulic transfer can be used as the activator in the present invention. Specific examples include toluene, xylene, ethylbenzene, hexane, cyclohexane, methyl ethyl ketone, methyl isobutyl ketone, ethyl acetate, butyl acetate, propyl acetate, isobutyl acetate, 1-propanol, 2-propanol, 1-butanol, 2-butanol, ethyl cellosolve, cellosolve acetate, butyl cellosolve, carbitol, carbitol acetate, butyl carbitol acetate, Solfit acetate, mineral spirits, and mixtures thereof.

15 [0055]

In order to enhance the adhesion between the printed ink or coating and the molded body, a small quantity of a resin component may be incorporated within the activator. The adhesion can be enhanced by including from 1 to 10% of a resin having a

20 structure resembling an ink binder, such as a polyurethane, acrylic resin, or epoxy resin.

[0056]

To achieve the same object, the radical polymerizable compound or photopolymerization initiator described above may also be dissolved within the activator.

[0057]

After the transfer layer has been hydraulically transferred to the transfer target body, the supporting film is removed either by dissolution in the water or peeling, and the resulting product is then dried. In a manner similar to a conventional hydraulic transfer method, the supporting film is dissolved or peeled off in a stream of water.

5 [0058]

After the water and the activator have dried, the curable resin layer is cured by irradiation with an active energy beam. The curing time depends on the composition and the type of curing agent, but in terms of the overall process, curing preferably takes from several minutes to one hour.

10 [0059]

(Molded product that functions as the target transfer body)

The curable resin forming layer or decorative layer can preferably sufficiently adhere to the surface of the molded product that acts as the transfer target body, and for this reason, a primer layer may be provided on the surface of the molded product if required. There are no particular restrictions on the resin used for forming the primer layer, and any of the resins conventionally used as primer layers are suitable, including urethane resins, epoxy resins, and acrylic resins. Furthermore, molded products formed from a resin component with high solvent absorption, such as ABS resin or SBS rubber which have good adhesion, do not need a primer. There are no particular restrictions on the material used to produce the molded product, and suitable materials include metal, plastic, wood, pulp mold, or glass, provided that an adequate level of waterproofness can be ensured after treatment with a primer, so that quality problems such as collapse of the molded product shape do not occur when submerged in water.

[0060]

Specific examples of molded products to which the present invention can be applied include household electric appliances such as televisions, video recorders, air conditioners, radio cassette players, mobile phones, and refrigerators, OA equipment such as personal computers and printers, and the housings of household products such as oil fan heaters and cameras. Furthermore, the present invention can be widely used in a variety of fields, and is of particular advantage when used with molded products that have curved surfaces and require design freedom, including furniture such as tables, wardrobes, and columns, building components such as bathtubs, component kitchens, doors, window frames, and crown moldings, sundries such as writing implements, 10 electronic calculators, PDAs, and cases, as well as stationery, interior panels for automobiles, exterior panels for automobiles and motorcycles, hubcaps, ski carriers, carrier bags for fixing to automobiles, golf clubs, marine parts for yachts and the like, skis, snowboards, helmets, goggles, and monuments.

[EXAMPLES]

15 [0061]

As follows is a description of specifics of the present invention using a series of examples, although the present invention is in no way limited by these examples.

[0062]

(Reference example) Production of a printing film

20 Using an ink G1 with the composition shown below, a woodgrain pattern was gravure printed onto the surface of an unstretched polypropylene film of thickness 30 μm ("Pylen P1011" manufactured by Toyobo Co., Ltd.) using two solid plates and three pattern plates.

<Composition of ink, black, brown, white>

25 Burnock EZL676: 20 parts by weight (solid fraction equivalent)

Pigments (black, brown, white): 10 parts by weight (solid fraction)

Additives such as waxes: 10 parts by weight

Solvent: added to adjust the nonvolatile fraction to 30%

"Burnock EZL676" is a polyurethane manufactured by Dainippon Ink and Chemicals, Inc., and the solvent used was a mixture of toluene, ethyl acetate, and methyl ethyl ketone in a ratio of 2:1:1.

(Example 1) Production of a film for a hydraulic transfer with an ultraviolet curable resin layer and a hydraulic transfer

Solid print with a curable resin forming layer of a thickness of 10 g (solid fraction)/m² was gravure printed onto the surface of a polyvinyl alcohol resin film with a thickness of 35 µm by using two plates and a curable resin composition (1) with the formulation described below, and pattern print and solid print with thickness of 3 to 4 g (solid fraction)/m² were printed by using three plates and a printing ink with the formulation described below.

15 [0063]

(Curable resin forming layer composition (1))

Unidic 17-813: 50 parts by weight (solid fraction equivalent)

Acrypet VH: 50 parts by weight

Irgacure 184: 1 part by weight

20 Solvent: added to adjust the nonvolatile fraction to 30 weight%

"Unidic 17-813" is a polyurethane poly(meth)acrylate manufactured by Dainippon Ink and Chemicals, Inc. (weight average molecular weight: 1,500, Tg: about -20°C (DSC method)), "Acrypet VH" is a thermoplastic acrylic resin manufactured by Mitsubishi Rayon Co., Ltd. (weight average molecular weight: 200,000, Tg: 100°C),

"Irgacure 184" is a photopolymerization initiator manufactured by Ciba Specialty Chemicals Co., Ltd., and the solvent used was a mixed solvent of MEK, butyl acetate, toluene, and ethyl acetate.

[0064]

5 <Ink composition, black, brown, white>

Polyurethane (Burnock EZL676, manufactured by Dainippon Ink and Chemicals, Inc.) : 20 parts by weight

Pigments (black, brown, white): 10 parts by weight

Ethyl acetate-toluene (1/1): 60 parts by weight

10 Additives such as waxes: 10 parts by weight

[0065]

The obtained film for hydraulic transfer was placed in a water bath at 30°C with the decorative layer facing upwards and left for two minutes, and then 40 g/m² of an activator (xylene as a main component) was sprayed onto the film. After waiting a 15 further 10 seconds, a molded product made of ABS resin (an interior panel for an automobile) was pushed down in the vertical direction, thereby transferring the pattern. After the transfer was completed, the molded product was washed in water and dried for one minute at 90°C. The sample was then passed three times through a UV irradiation device (output 80 KW/m, conveyor speed 10 m/minute), yielding a glossy cured film.

20 [0066]

(Example 2) Production of a film for a hydraulic transfer with an ultraviolet curable resin layer and a hydraulic transfer

A film was produced by using a lip coater to coat a PVA film of thickness 30 µm (manufactured by Aicello Chemical Co., Ltd.) with a curable resin composition (2)

described below in sufficient quantity to generate a film (I) thickness of 20 μm when solid, and then drying the resulting film for two minutes at 60°C. The curable resin forming layer of this film (I) and the decorative layer of the printed film (II) created in the reference example were positioned facing each other, and were then laminated 5 together at 60°C. The laminated film was then wound, as is, thereby producing a film for hydraulic transfer C2.

The PP film was peeled off from this film for hydraulic transfer, and then the ink layer was transferred to the PVA film without defect. Peel force between the PP film and the decorative layer was low enough, 5 g/cm, and a wrinkle or groove was not formed in 10 the decorative layer.

[0067]

(Curable resin forming layer composition (2))

Unidic 17-813: 60 parts by weight (solid fraction equivalent)

Paraloid A11: 40 parts by weight (solid fraction)

15 Irgacure 184: 3 parts by weight (solid fraction)

Solvent: (added to adjust the nonvolatile fraction to 50 weight%)

"Paraloid A11" is a thermoplastic acrylic resin manufactured by Rohm and Haas Company (weight average molecular weight: 125,000, Tg: 100°C), and the solvent used was a mixed solvent of MEK, butyl acetate, toluene, and ethyl acetate.

20 [0068]

The obtained film for hydraulic transfer was then floated in a water bath at 30°C with the ink surface facing upwards and left for two minutes, and then 40 g/m² of the activator (xylene as a main component) was sprayed onto the film. After leaving the film for a further 10 seconds, a primer coating surface of a primer-coated steel sheet of 0.5

mm thick was pushed down in the vertical direction, thereby transferring the pattern. After the transfer was completed, the transfer target body was washed in water and dried for 20 minutes at 90°C. The sample was then passed one time through a UV irradiation device (output 160 W/cm, conveyor speed 5 m/minute), yielding a glossy cured film.

5 [0069]

(Example 3) Production of a film for a hydraulic transfer with an ultraviolet curable resin layer and a hydraulic transfer

After forming a curable resin forming compound C on a PVA film in the same manner as the example 2, a decorative film was laminated thereon to form a decorative 10 layer on top of the curable resin layer. The obtained film for hydraulic transfer C3 was then hydraulically transferred onto an automobile door panel made of ABS resin in the same manner as in the example 2, yielding a glossy cured film.

[0070]

(Curable resin forming layer composition (3))

15 Unidic 17-813: 60 parts by weight (solid fraction equivalent)

Paraloid A11: 20 parts by weight (solid fraction)

Paraloid B60: 20 parts by weight (solid fraction)

Irgacure 184: 3 parts by weight (solid fraction)

Solvent: (added to adjust the nonvolatile fraction to 50 weight%)

20 "Paraloid B60" is a thermoplastic acrylic resin manufactured by Rohm and Haas Company (weight average molecular weight: 50,000, Tg: 75°C).

[0071]

(Example 4) Production of a film for a hydraulic transfer with an ultraviolet curable resin layer and a hydraulic transfer

After forming a curable resin forming compound D on a PVA film in the same manner as the example 2, a decorative film was laminated thereon to form a decorative layer on top of the curable resin layer. The thus obtained film for hydraulic transfer was then hydraulically transferred onto an automobile door panel made of ABS resin in the 5 same manner as in the example 2, yielding a glossy cured film.

[0072]

(Curable resin forming layer composition (4))

New Frontier R-2402: 50 parts by weight (solid fraction equivalent)

Aronix M-305: 10 parts by weight (solid fraction equivalent)

10 Paraloid A11: 40 parts by weight (solid fraction)

Irgacure 184: 3 parts by weight (solid fraction)

Solvent: (added to adjust the nonvolatile fraction to 50%)

"New Frontier R-2402" is a polyester acrylate manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd. (weight average molecular weight: 1,590, Tg: -45°C), and "Aronix M-15 305" is a mixed compound of pentaerythritol triacrylate/pentaerythritol tetraacrylate manufactured by Toagosei Co., Ltd. (weight average molecular weight: 350, Tg: -49°C).

[0073]

(Example 5) Production of a film for a hydraulic transfer with an ultraviolet curable resin layer and a hydraulic transfer

20 After forming a layer of a curable resin forming layer composition D on a PVA film in the same manner as the example 2, a decorative film was laminated thereon to form a decorative layer on top of the curable resin forming layer. The thus obtained film for hydraulic transfer was hydraulically transferred onto an automobile door panel made of ABS resin in the same manner as in the example 2, yielding a glossy cured film.

[0074]

(Curable resin forming layer composition (5))

Unidic V5500: 60 parts by weight (solid fraction equivalent)

Byron 200: 40 parts by weight (solid fraction)

5 Irgacure 184: 3 parts by weight (solid fraction)

Solvent: (added to adjust the nonvolatile fraction to 50 weight%)

"Unidic V5500" is a bifunctional epoxy acrylate manufactured by Dainippon Ink

and Chemicals, Inc. (weight average molecular weight: 1,070, Tg: -4°C), and "Byron

200" is a polyester resin manufactured by Toyobo Co., Ltd. (weight average molecular

10 weight: 28,000, Tg: 67°C).

[0075]

(Comparative example 1) Production of a film for a hydraulic transfer with an ultraviolet curable resin layer and a hydraulic transfer

Solid print with a curable resin layer of a thickness of 10 g (solid fraction)/m² was

15 gravure printed onto the surface of a polyvinyl alcohol resin film of thickness 35 µm by using two plates and a curable resin composition with the composition shown below, and pattern print and solid print with a thickness of 4 g (solid fraction)/m² were printed by using three plates and a printing ink with the formulation shown below.

[0076]

20 (Curable resin forming layer composition (6))

Radical reactive acrylic resin (a): 97 parts by weight (solid fraction equivalent)

Irgacure 184: 3 parts by weight (solid fraction)

Solvent: (added to adjust the nonvolatile fraction to 28 weight%)

The radical reactive acrylic resin (4) is an active energy beam curable resin with a Tg of 85°C having methacrylic group side chains, produced by first dissolving a poly(meth)acrylate (weight average molecular weight 105,000), produced by copolymerizing methyl methacrylate, ethyl acrylate, butyl acrylate, and hydroxyethyl 5 methacrylate in a molar ratio of 40/10/10/20, in toluene to produce a 30% solution, and then adding 10 parts by weight of an acrylic isocyanate monomer MOI manufactured by Showa Denko K.K. and stirring for one hour at 50°C.

[0077]

<Ink composition, black, brown, white>

10 Polyurethane (product name "Burnock EZL676", manufactured by Dainippon Ink and Chemicals, Inc.): 20 parts by weight

Pigments (black, brown, white): 10 parts by weight

Ethyl acetate-toluene (1/1): 60 parts by weight

Additives such as waxes: 10 parts by weight

15 [0078]

When the obtained film for hydraulic transfer was placed in a water bath at 30°C for two minutes with the ink surface facing upwards, and the film was then sprayed with 50 g/m² of the activator (methyl isobutyl ketone as a main component), although the ink coating film dissolved, the curable resin forming layer underwent almost no dissolution, 20 and favorable hydraulic transfer could not be achieved.

[0079]

(Comparative example 2)

After forming a layer of a curable resin forming layer composition (7) on a PVA film in the same manner as in the example 2, a decorative film was laminated thereon,

thereby forming a decorative layer on the curable resin layer. However, after several days wrinkles appeared in the curable resin layer of the obtained film for hydraulic transfer, rendering it unusable. In terms of hydraulic transferability, because the curable resin layer dissolved quickly and did not balance well with the solubility of the ink, the 5 pattern of the decorative layer was deformed, and a satisfactory transferred product could not be obtained.

[0080]

(Curable resin forming layer composition (7))

Beamset 700: 100 parts by weight (solid fraction equivalent)

10 Irgacure 184: 3 parts by weight

Solvent: (added to adjust the nonvolatile fraction to 30 weight%)

Beamset 700 is a polyacrylate manufactured by Arakawa Chemical Industries, Ltd. (weight average molecular weight: 570, liquid form).

(Comparative example 3)

15 A hydraulic transfer film was obtained in the same manner as in the example 1 except using the following a layer of a curable resin forming layer composition (8)

(Curable resin forming layer compound (8))

Unidic 17-813: 25 parts by weight (solid fraction equivalent)

Paraloid A11: 75 parts by weight

20 Irgacure 184: 1 part by weight

Solvent: added to adjust the nonvolatile fraction to 30 weight%

A hydraulic transfer was conducted by using the resulting film for hydraulic transfer in the same manner as in the example 1. However, the curable resin forming layer underwent almost no dissolution although the ink coating film dissolved, and

25 favorable hydraulic transfer could not be achieved.

(Comparative example 4)

A hydraulic transfer film was obtained in the same manner as in the example 1 except using the following a layer of a curable resin forming layer composition (9)

(Curable resin forming layer composition (9))

5 Unidic 17-813: 75 parts by weight (solid fraction equivalent)

Paraloid A11: 25 parts by weight

Irgacure 184: 1 part by weight

Solvent: added to adjust the nonvolatile fraction to 30 weight%

Blocking was occurred in some part of the resulting hydraulic transfer sheet in
10 rolling state. A hydraulic transfer was conducted in the same manner as in the example 1. However, because the activation was too fast, the curable resin layer could not maintain the appearance, and became a hydraulic transfer body with the pattern of the decorative being deformed.

[0081]

15 Table 1 shows the compositions of the curable resin layers in the examples and comparative examples, and also shows the weight ratio P of the radical polymerizable compound (B) relative to the thermoplastic resin (A) within the curable resin forming layer.

[0082]

20 [Table 1]

	Radical polymerizable compound (B)	Thermoplastic resin (A)	Weight ratio P: (B)/(A)
Example 1	B1: Unidic 17-813 1,500/-20°C	Acrypet VH 200,000/100°C	50/50
Example 2	B1: Unidic 17-813 1,500/-20°C	Paraloid A11 125,000/100°C	60/40
Example 3	B1: Unidic 17-813 1,500/-20°C	Paraloid A11 125,000/100°C Paraloid B60 50,000/75°C	60/40
Example 4	B1: New frontier R-2402 1,590/-45°C B2: Aronix M-305 350/-49°C	Paraloid A11 125,000/100°C	60/40
Example 5	B1: Unidic V5500 1,070/-4°C	Byron 200 28,000/67°C	60/40
Comparative example 1	Radical reactive acrylic resin	105,000/85°C	
Comparative example 2	Beamset 700 570/liquid		
Comparative example 3	B1: Unidic 17-813 1,500/-20°C	Paraloid A11 125,000/100°C	25/75
Comparative example 4	B1: Unidic 17-813 1,500/-20°C	Paraloid A11 125,000/100°C	75/25

[0083]

(Transferred body test methods)

5 Various properties of the samples obtained in the examples were tested as follows.

[0084]

(Storage property of film)

The films for hydraulic transfer obtained the examples and comparative examples were rolled up with 50 m length in the state of 3 inches diameter paper roll with 360 mm 10 width, and packaged with an evaporated aluminium film. After that, the films were stored

in the constant temperature condition of 20 to 25°C and the constant humidity condition of 40 to 60%. The appearance of the films was observed every one week during the storage.

[0085]

5 (Hydraulic transferability)

In the hydraulic transfer process in the examples and comparative examples, samples in which no surface defects were detected and the pattern was reproduced faithfully were evaluated using the symbol O, whereas those samples with obvious surface defects or a fragmented pattern were evaluated using the symbol x.

10 [0086]

(Surface luster evaluation)

Surface luster was evaluated in accordance with JIS-K5400 "7.6 Specular gloss", by measuring the specular gloss at an incident angle of 60 degrees.

[0087]

15 (Abrasion resistance evaluation)

An abrasion test was conducted using traverse test equipment, wherein #000 steel wool was applied for 5 cycles (back and forth) under a load of 1 kg/9cm², the luster was then remeasured in the same manner as in the surface luster evaluation.

[0088]

20 (Scratch resistance evaluation)

The pencil hardness of the coating film was measured using a "pencil scratch tester for coated film" according to JIS-K5401. The thickness of the pencil lead was 3 mm, the angle relative to the coating film was 45 degrees, the load was 1 kg, the scratch

speed was 0.5 mm/minute, the scratch length was 3 mm, and the pencils used were Mitsubishi Uni pencils.

[0089]

(Solvent resistance test)

5 A rubbing tester was used to rub the sample 100 times (back and forth) with absorbent cotton impregnated with MEK, using an applied weight of 1 kg, and the surface of the coating film was then examined. Samples for which there was no discoloration or change in luster were evaluated using the symbol O, whereas samples in which discoloration and/or change was observed were evaluated using the symbol x.

10 [0090]

Table 2 shows the coating film test results of using a transferred body wherein the resin composition and printing ink in examples 1 and 2 were transferred on 10 cm × 10 cm panel made of ABS in the same manner as in examples 4 to 6. In examples 1 to 4, the hydraulic transfer could be performed in the same manner as the prior hydraulic transfer 15 film only having an ink layer. In addition, the hydraulic transferred curable resin (coating film) shows high scratch resistance and gloss value, and the film can be used for 3 months or more. However, although the film was possible to store, the hydraulic transfer could not be performed in comparative example 1. The film was not possible to store due to the fluidity of the curable resin forming layer in comparative example 2.

20 Further, the hydraulic transferability was not good because the curable resin forming layer diffused before the activation of the printing layer due to high dissolution of the curable resin forming layer. Test for the coating properties was not possible because the hydraulic transferred body enough to get test was not obtained in comparative examples 3 and 4.

[0091]

[Table 2]

	Film storage	Hydraulic transferability	Gloss value	Abrasion resistance	Scratch resistance	Solvent resistance
Example 1	O	O	83	95	4H	O
Example 2	O	O	80	92	3H	O
Example 3	O	O	90	85	2H	O
Example 4	O	O	82	89	2H	O
Example 5	O	O	90	80	H	O~Δ
Comparative example 1	O	×	55	70	H	×
Comparative example 2	×	×	65	69	H	Δ
Comparative example 3	O	×	-	-	-	-
Comparative example 4	×	×	-	-	-	-

5 [Industrial Applicability]

[0092]

A film for hydraulic transfer of the present invention can be widely used in a variety of fields, and is of particular advantage when used with molded products that have curved surfaces and require favorable design features.

[Document Type] Claims

[Claim 1]

A film for hydraulic transfer having a supporting film comprising a water-soluble or water-swelling resin, and a transfer layer that is soluble in organic solvent provided on

5 top of said supporting film, in which

said transfer layer comprises a curable resin forming layer that is curable by irradiation with at least one of an active energy beam or heat, wherein

said curable resin forming layer comprises:

1) a thermoplastic resin (A) selected from the group consisting of acrylic resins and

10 polyester resins having a weight average molecular weight within a range from 5,000 to 300,000, and,

2) a radical polymerizable compound (B) selected from the group consisting of epoxy acrylates, polyester acrylates, urethane acrylates, and polyether acrylates, having a weight average molecular weight 10,000 or less and being compatible with said

15 thermoplastic resin (A), and

a weight ratio P of the radical polymerizable compound (B) relative to the thermoplastic resin (A) (a combined weight of the polymerizable compound (B)/a combined weight of the thermoplastic resin (A)) in the curable resin forming layer being within a range from 45/55 to 70/30, and

20 the radical polymerizable compound (B) comprises a radical polymerizable compound (B1) having a weight average molecular weight within a range from 700 to 3,000.

[Claim 2]

The film for hydraulic transfer according to claim 1, wherein a combined weight of said thermoplastic resin (A) and said radical polymerizable compound (B) within said curable resin forming layer is 60 weight% or greater.

[Claim 3]

5 The film for hydraulic transfer according to claim 1 or 2, wherein said thermoplastic resin (A) selected from the group consisting of acrylic resins having a weight average molecular weight within a range from 20,000 to 300,000 and polyester resins having a weight average molecular weight within a range from 5,000 to 50,000,

[Claim 4]

10 The film for hydraulic transfer according to any one of claims 1 to 3, wherein a weight ratio P of the radical polymerizable compound (B) relative to the thermoplastic resin (A) (a combined weight of the polymerizable compound (B)/a combined weight of the thermoplastic resin (A)) in the curable resin forming layer being within a range from 45/55 to 60/40, and a decorative layer is formed by gravure printing on the curable resin 15 forming layer.

[Claim 5]

The film for hydraulic transfer according to any one of claims 1 to 3, wherein a weight ratio P of the radical polymerizable compound (B) relative to the thermoplastic resin (A) (a combined weight of the polymerizable compound (B)/a combined weight of 20 the thermoplastic resin (A)) in the curable resin forming layer being within a range from 50/50 to 70/30, and the decorative layer is transferred onto the curable resin layer by using dry lamination to bond the curable resin forming layer to the decorative layer 25 provided on the substrate film.

[Claim 6]

The film for hydraulic transfer according to any one of claims 1 to 5, wherein said radical polymerizable compound (B) further comprises a radical polymerizable compound (B2) with a weight average molecular weight of at least 200 but less than 700 and being compatible with the thermoplastic resin (A).

5 [Claim 7]

The film for hydraulic transfer according to claim 6, wherein a weight ratio Q of the radical polymerizable compound (B2) relative to the radical polymerizable compound (B1) (a combined weight of the radical polymerizable compound (B2)/a combined weight of the radical polymerizable compound (B1)) in the curable resin forming layer 10 being not more than 20/80.

[Claim 8]

The film for hydraulic transfer according to any one of claims 1 to 7, wherein Tg of the thermoplastic resin (A) is within a range from 25 to 250°C.

[Claim 9]

15 The film for hydraulic transfer according to any one of claims 1 to 8, wherein Tg of the radical polymerizable compound (B) is less than 0°C.

[Claim 10]

The film for hydraulic transfer according to any one of claims 1 to 9, wherein at least one of the thermoplastic resin (A) is a poly (meth)acrylate.

20 [Claim 11]

The film for hydraulic transfer according to any one of claims 1 to 10, wherein at least one of the radical polymerizable compound (B1) is a urethane acrylate.

[Claim 12]

The film for hydraulic transfer according to any one of claims 6 to 11, wherein at least one of the radical polymerizable compound (B2) is a mixed compound of pentaerythritol triacrylate and pentaerythritol tetraacrylate.

[Claim 13]

5 A hydraulically transferred body, characterized by hydraulically transferring a film for hydraulic transfer according to any one of claims 1 to 12 to said transfer target body.

[Document Type] ABSTRACT

[Abstract]

[Problems to be solved by the Invention]

The present invention provides a hydraulic transfer film showing a high hardness,
5 solvent resistance due to curing after transfer wherein a curable resin forming layer has
the coating film forming ability and the adherence property onto a supporting film in a
non-cure state, and the non-adhesive property after drying, and shows a good appearance
maintenance property even after forming the hydraulic transfer film, and an activation is
possible.

10 [Means for solving the Problems]

A film for hydraulic transfer includes a curable resin forming layer wherein
1) a thermoplastic resin selected from the group consisting of acrylic resins and
polyester resins having a weight average molecular weight within a range from 5,000 to
300,000, and,

15 2) a radical polymerizable compound selected from the group consisting of epoxy
acrylates, polyester acrylates, urethane acrylates, and polyether acrylates, having a
weight average molecular weight 10,000 or less and being compatible with the
thermoplastic resin, and

a weight ratio P of the radical polymerizable compound/the thermoplastic resin
20 being within a range from 45/55 to 70/30, and

the radical polymerizable compound comprises a radical polymerizable compound
having a weight average molecular weight within a range from 700 to 10,000.

[Selected Drawing] none